BIRD TECHNOLOGIES GROUP

# MILITARY & GOVERNMENT


BIRD Electronic Corporation

RF Measurement and Management in Your World

TX RX SYSTEMS INC.

# Introduction

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# Government and Military Market

- Bird Technologies Group has a strong history of serving the Military

- Product Development for Military Troops Since WWII

- Today, Bird has a Global presence by providing products for foreign militaries.

- Military Applications
  - Field testing Tactical Radio Systems
  - Flight line and avionics systems
  - Custom built filters and sensors, power measurement, resistive products and subassemblies.
  - Integrated antenna analysis.

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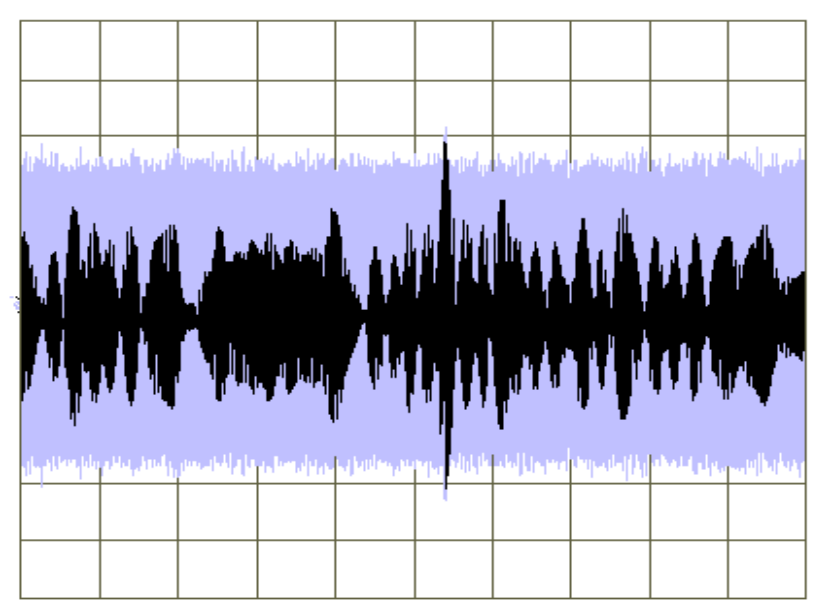
# Modern Radio

- JTRS Software-Defined Radio
- Complex Modulation Schemes
- Smaller Radios
- Greater Functionality

# Complex Signals

- Wider Dynamic Range
- More modulation schemes
- Encryption
- Combined signals
- Digital Waveforms



# We Will Discuss

- Square law detectors
- Transmatch power measurements
- Comparing power measurements
- Customization of square law detectors



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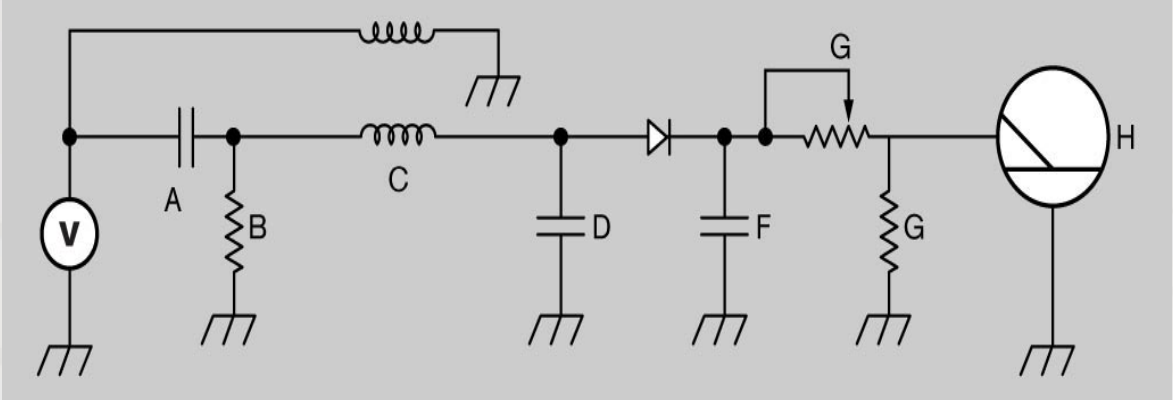
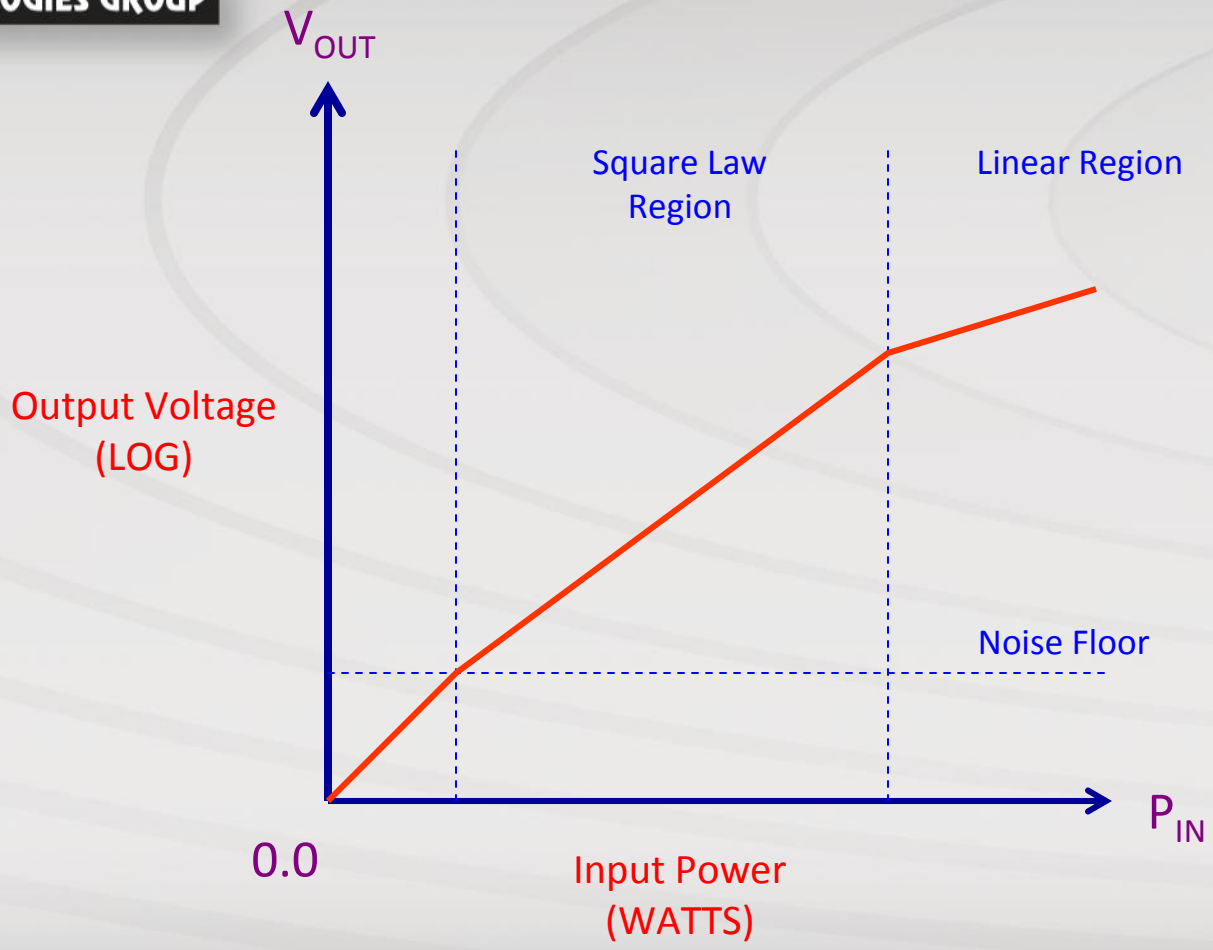
# Square Law Theory

# Conventional

- Peak Power Detection
- All 3 Regions
  - Square law
  - Transition
  - Linear
- Inaccuracy with complex signals



# Diode Detector Operating Regions

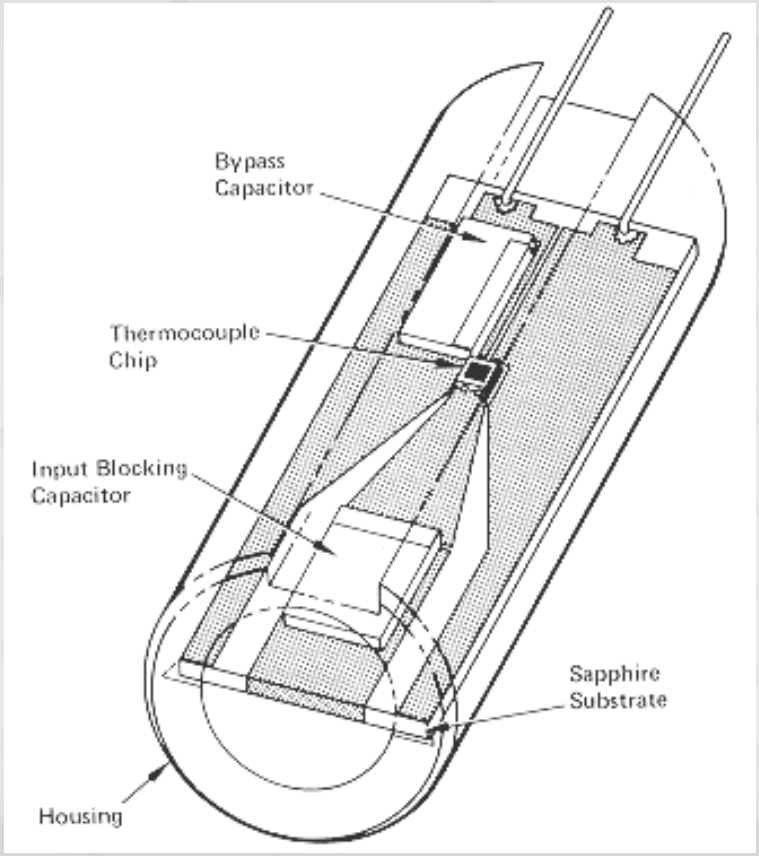


- Operating completely in the square law region gives us a response of:

$$V_{out} = \left(\frac{Vin}{5.77}\right)^2$$

- This Characteristic Will Hold True Regardless Of The Input Waveform Characteristic.
- Dynamic Range Of This Approach Is Bound By Approximately -20dBm On The High Side, And Noise On The Low Side.

# Transmatch Power Measurements



# Thermoelectric Converters

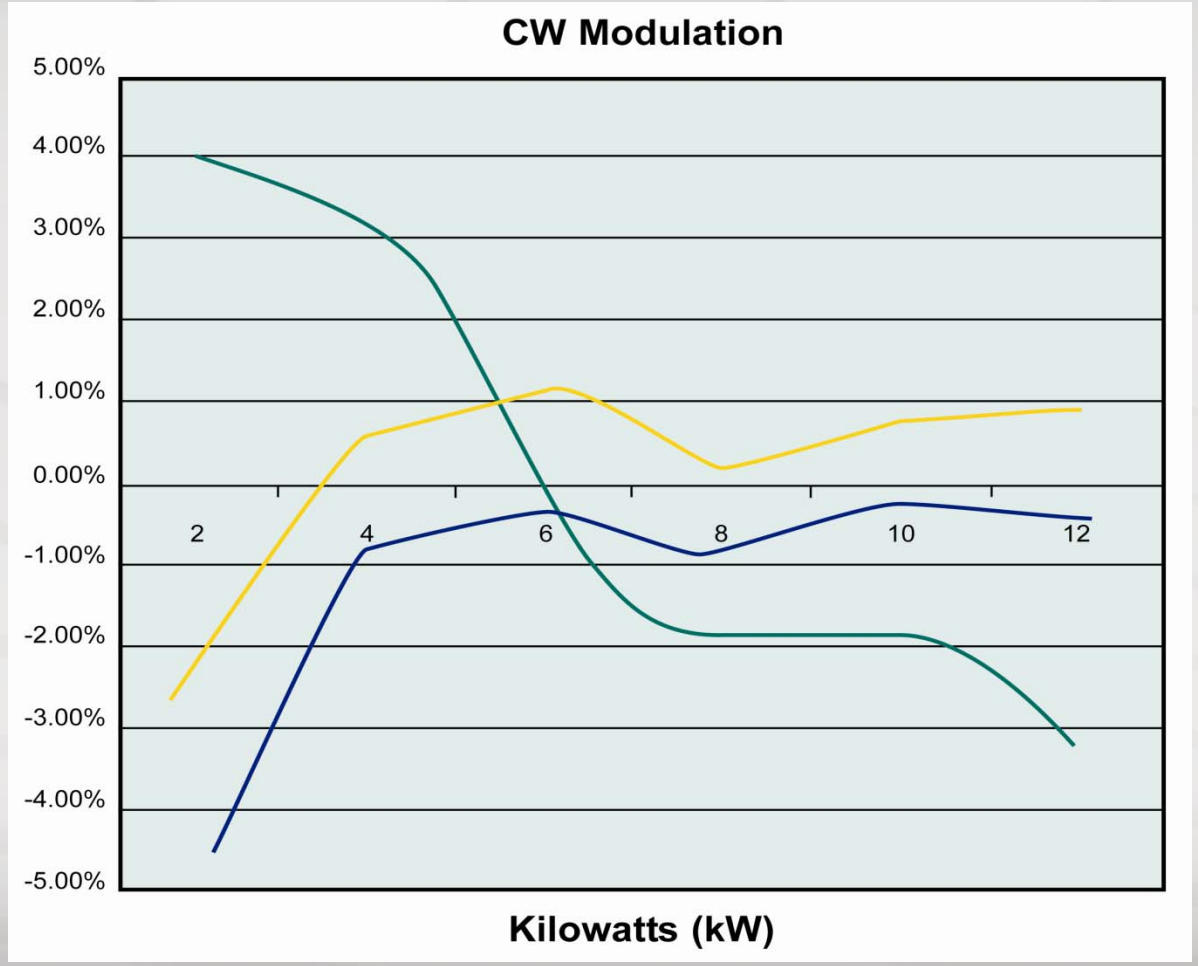
- Similar to Calorimetric Instruments, RF Power is Proportional to Heat.
- May be Calibrated using DC Substitution Techniques.
- Wide Dynamic Range.
- Power Measurement Includes Fundamental and All Harmonics.
- Typically Present a Low VSWR to the Transmission System.
- Independent of Modulation Format.
- Small size.

# Measurement Comparison

# Structure

- Compare techniques to a calorimeter
  - Square Law
  - Conventional
  - Thermal
- Compared in three situations
  - CW
  - 8 VSB
  - COFDM

# Measurement Results, CW Signal

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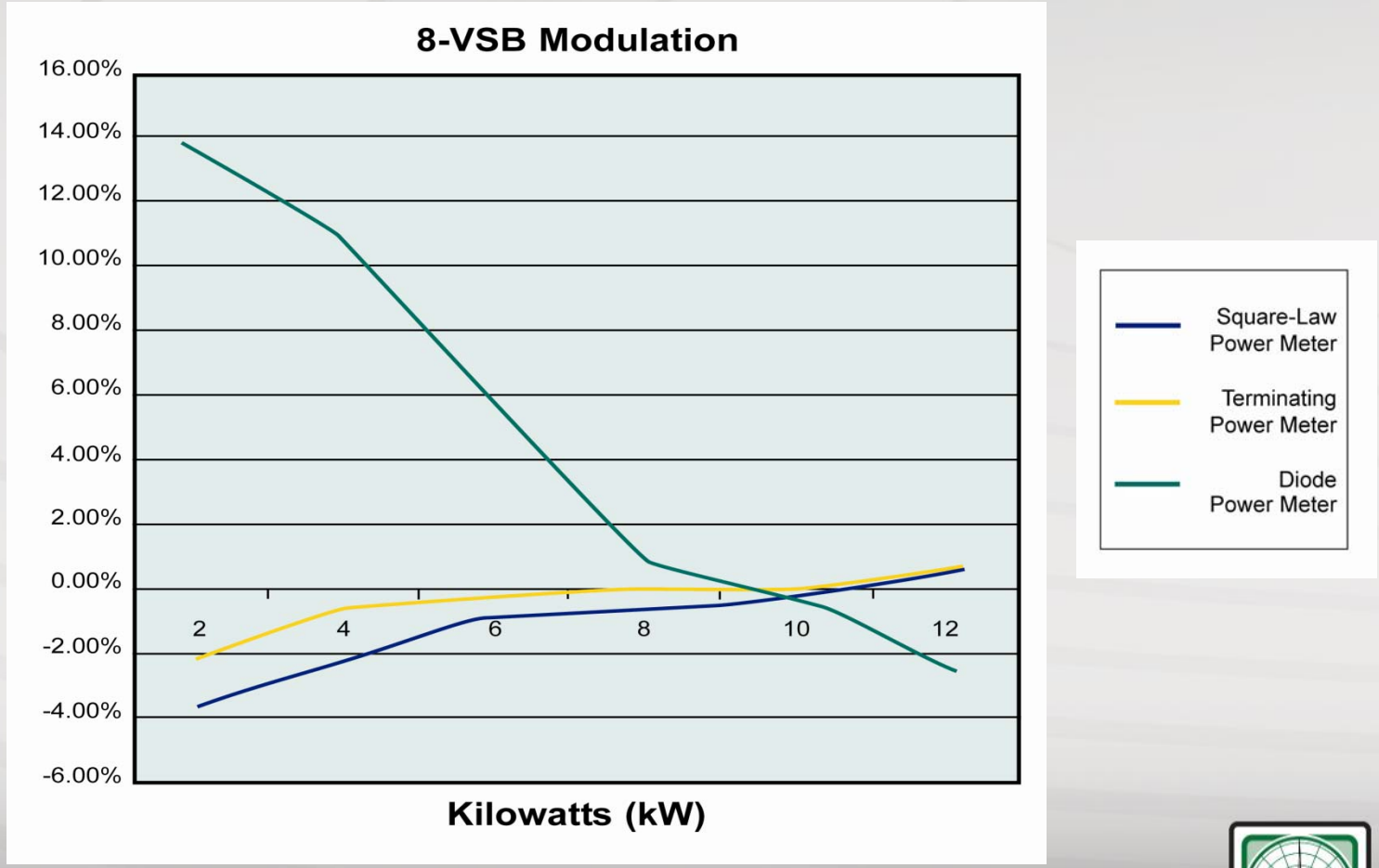
# Measurement Results, 8-VSB

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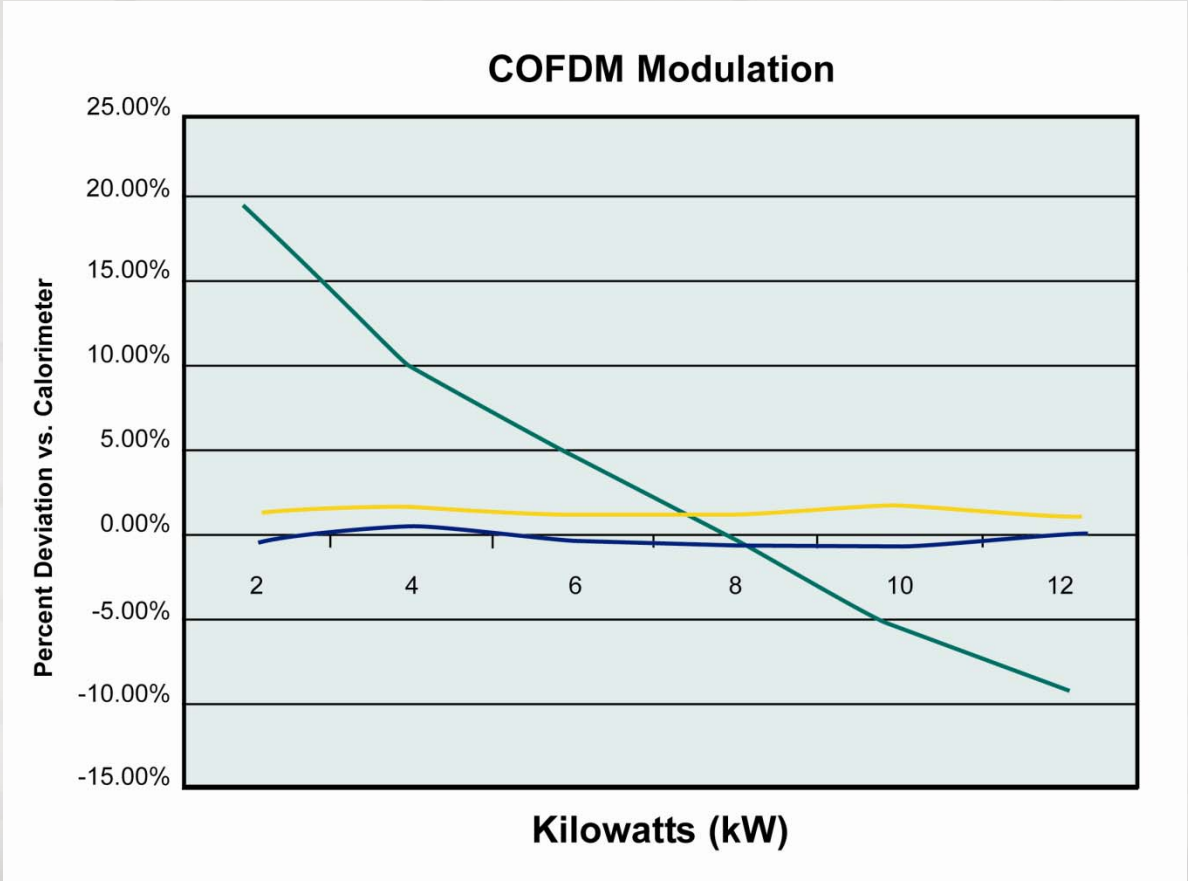
# Measurement Results, COFDM Modulation



# Integrated Diode Power Meter Error Budget

| | | | |
|---|---|---|---|
| 1 | Directional Coupler Frequency Response Error | +/-3.0% | Includes frequency response error for forward and reflected measurements. Does not include directivity effects on reflected channel. |
| 2 | Detector Linearity | +/- 1.5% | Includes detector linearity over a 20 dB dynamic range |
| 3 | Instrumentation Uncertainty and Noise | +/-1.5% | |
| 4 | Temperature Drift | +/-1.5% | Assumes a 7 degree C ambient temperature range |
| 5 | Calibration Standards Uncertainty | +/- 0.75% | Uncertainty of working standards on production floor |
| | Worse Case Error | +/-8.25% | |
| | RSS (Probable) Error | +/-4.04% | Error sources may be treated as independent variables |

# Error Analysis of Thermal Power Measurement System

| | Error Component | Error Value | |
|---|---|---|---|
| 1 | Instrumentation Uncertainty & Noise | ± 1.5% | |
| 2 | Power Reference Uncertainty | ± 1.2% | Thermal power meters require the use of a reference oscillator. This is typically a 50 MHz, 1 mW source. |
| 3 | Calibration Factor Uncertainty | ± 3% | The accuracy to which specified sensor calibrations are known. |
| 4 | Mismatch Uncertainty (based upon a source VSWR of 1.5 and a load VSWR of 1.2) | ± 4% | Based upon a source VSWR (directional coupler side arm) of 1.5, and a sensor VSWR of 1.2. |
| 5 | Attenuation Factor Uncertainty | ± 1% | Using a 50dB Directional Coupler and an HP8753D Network Analyzer, the best possible attenuation measurement is ± .05dB. |
| 6 | Linearity | ± 1% | |
| 7 | Temperature Drift | ± 1.6% | Assuming a 7°C total spread in ambient temperature at measurement point. |

**Worst Case Error** ± 13.3%
**Probable Error** ± 5.8%

# Customization

# Requirements

- Compact
- Robust
- Speed
- Accuracy
- Size

# Configurable Power Sensor

- 0-5 Vdc output, linear with power
- Custom connectors
  - RF connectors
  - DC connectors
- Custom Application
  - Power Level
  - Frequency

# Conclusion

- Square Law detectors provide accuracy in software defined radio
- Ideal for situations requiring a high level of resilience
- The CPS can be customized to fit any application

# Questions?

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